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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/671,233	09/25/2003	Jian H. Zhao		8199

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LERNER, DAVID, LITTENBERG,  
KRUMHOLZ & MENTLIK  
600 SOUTH AVENUE WEST  
WESTFIELD, NJ 07090

EXAMINER

TRAN, TAN N

ART UNIT PAPER NUMBER

2826

DATE MAILED: 10/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/671,233

Applicant(s)

ZHAO, JIAN H.

Examiner

TAN N. TRAN

Art Unit

2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on amendment filed on 07/10/06.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 12-31 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 12-31 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date <u>07/10/06</u> . | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

**Claim Objections**

1. Claims 20,21,30,31 are objected to because of the following informalities:

In claims 20,30, line 3, "0.3 um" should be changed to – 0.3 micrometer--.

In claims 21,31, line 3, "0.5 um and 3.5um" should be changed to – 0.5 micrometer and 3.5 micrometer --.

Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 19,29 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 19, lines 2-4, "the vertical gate junctions are perpendicular to said source layer to within twenty degrees ( $20^0$ )" is unclear as to what does applicant mean by the vertical gate junctions are perpendicular to said source layer to within twenty degrees ( $20^0$ )?

In claim 29, lines 2-4, "the vertical p<sup>+</sup>n gate junctions are perpendicular to said source layer to within twenty degrees ( $20^0$ )" is unclear as to what does applicant mean by the vertical p<sup>+</sup>n gate junctions are perpendicular to said source layer to within twenty degrees ( $20^0$ )?

**Claim Rejections - 35 USC § 102**

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 12-19,22-29 are rejected under 35 U.S.C. 102(a) as being anticipated by Zhao et al., “Demonstration of a high performance 4H-SiC vertical junction field effect transistor without epitaxial regrowth”, Feb. 2003, pp. 321-323, Electronics Letters, IEEE, Stevenage, SG1 2SD, UK.

With regard to claims 12,22, Zhao et al. discloses n<sup>+</sup> type substrate layer serves as a drain layer of heavily doped semiconductor of a first conductivity type and operable as a drain for said transistor; a blocking layer of lightly doped semiconductor of the first conductivity type (n<sup>-</sup>-type) formed on top of said drain layer; a channel layer formed on top of said blocking layer; the channel layer having a plurality of vertical channels of the first conductivity type spaced apart by U-shaped regions (p<sup>+</sup> gate) heavily doped semiconductor of the second conductivity type; second conductivity type having an opposite conductivity of the first conductivity type; wherein the sides of the U-shaped regions form vertical gate junctions with said vertical channels; and a source layer of very heavily doped semiconductor of the first conductivity type (n<sup>+</sup>-type) on top of said vertical gate junctions and operable as a source for said transistor; wherein said vertical

gate junctions produce a vertical channel opening of a uniform width for operation of the VJFET.  
(Note see attachment below, fig. 1 of Zhao et al.).

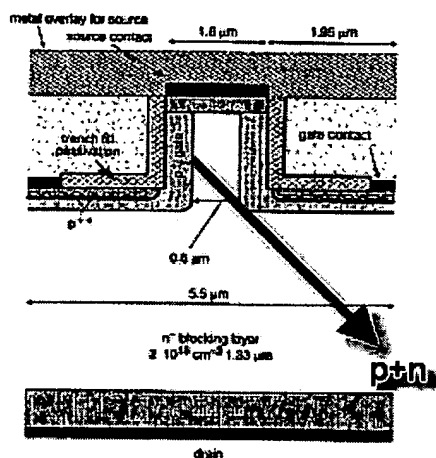


Fig. 1 Cross-sectional view of VJFET

With regard to claims 13,23, Zhao et al. discloses the U-shaped regions are doped by angled ion implantation. (Note lines 19-23, page 322, see attachment above, fig. 1 of Zhao et al.).

With regard to claims 14,24, Zhao et al. discloses gate ohmic contacts to very heavily doped semiconductor of the second conductivity type (p++-type) formed on the inside bottom of the U-shaped regions. (Note see attachment above, fig. 1 of Zhao et al.).

With regard to claims 15,25, Zhao et al. discloses passivation regions covering the sides of the U-shaped regions, at least part of the gate ohmic contacts, and the sides of the source layer on top of said vertical gate junctions. (Note see attachment above, fig. 1 of Zhao et al.).

With regard to claims 16,26, Zhao et al. discloses a dielectric fill layer filling an area between the sides of the passivation regions. (Note see attachment above, fig. 1 of Zhao et al.).

With regard to claims 17,27, Zhao et al. discloses a metal ohmic contact layer on top of the source layer. (Note see attachment above, fig. 1 of Zhao et al.).

With regard to claims 18,28, Zhao et al. discloses the VJFET is a normally-off transistor. (Note lines 4,5, page 322, see attachment above, fig. 1 of Zhao et al.).

With regard to claims 19,29, Zhao et al. discloses vertical gate junctions (pn junction) are perpendicular to said source layer. (Note see attachment above, fig. 1 of Zhao et al.).

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 20,21,30,31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao et al., "Demonstration of a high performance 4H-SiC vertical junction field effect transistor without epitaxial regrowth", Feb. 2003, pp. 321-323, Electronics Letters, IEEE, Stevenage, SG1 2SD, UK.

With regard to claims 20,21,30,31, Zhao et al. discloses all the claimed subject matter except for an opening dimension of the vertical channel opening is uniform to within 0.3 micrometer and the vertical channel opening has a channel length ( $L_{vc}$ ) between 0.5 micrometer and 3.5 micrometer. However, although Zhao et al. does not teach exact the dimension of the vertical channel opening and the vertical channel opening has a channel length as that claimed by Applicant, the dimension and length differences are considered obvious design choices and are not patentable unless unobvious or expected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious.

Note in re Leshin, 125 USPQ 416. Moreover, there is no evidence indicating that the dimension of the vertical channel opening and the vertical channel opening has a channel length is critical and it has been held that it is not inventive to discover the optimum or workable thickness range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

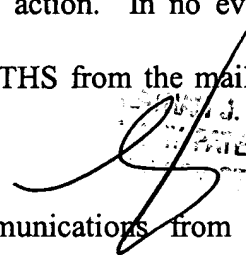
### ***Conclusion***

5. Applicant's submission of an information disclosure statement under 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p) and applicant's amendment on 07/10/06 necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 609.04(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

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CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

  
NATHAN J. FLYNN  
PATENT EXAMINER  
OCTOBER 2006

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to TAN N. TRAN whose telephone number is (571) 272-1923. The examiner can normally be reached on 8:30-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NATHAN FLYNN can be reached on (571) 272-1915. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TT  
Sep 2006